Author: Ismail Saidi
Date: January 2026

The standard spacetime graph—with time on one axis and space on another—appears in nearly every physics textbook. It has become so ubiquitous that we rarely question whether it represents fundamental reality or merely provides a convenient framework for calculation. This paper argues for the latter. The graph is a user interface, a tool for observers to track motion and make predictions. It is not a map of what the universe actually is.

When we examine what space and time might be at a fundamental level, a different picture emerges. Rather than treating them as independent dimensions or a pre-existing stage, we can understand both as manifestations of a single phenomenon: the movement and configuration of light. This perspective leads to a unified framework where matter, gravity, space, and cosmic expansion are all expressions of light in different states.

Space as the Movement of Light

The conventional view treats space as a container—an empty volume in which objects exist and events occur. But this raises immediate problems. What is this container made of? How does it exist independently of its contents? Why does it have properties like metric geometry?

An alternative is to recognize that space is not a container at all. Space is constituted by the movement of light itself. Where light propagates, space exists. The movement of electromagnetic radiation through the vacuum is not something that happens “in” space; it is what space is.

This resolves the conceptual problem of empty space. There is no such thing as true emptiness in this framework. What we call empty space is simply a region where light exists in a diffuse state, creating a weak field. Space is the field, and the field is present wherever light—in any form—exists.

Time as Light Progression

Time presents a similar issue. The spacetime graph suggests that past, present, and future all exist simultaneously in a four-dimensional block. This block universe view has philosophical appeal but creates paradoxes about causation and free will. More fundamentally, it treats time as ontologically equivalent to space, which conflicts with our direct experience of temporal flow and the thermodynamic arrow of time.

If we abandon the graph’s implications, we can understand time more simply: time is the progression of light. It is the measure of how far light has traveled, how much change has occurred in the electromagnetic field. The future does not exist because light has not yet progressed there. The past exists only as a record—as light that has already moved and left effects in its wake.

This makes time real and asymmetric, consistent with observation. It also explains why the speed of light is absolute: c is not merely the speed at which light travels through space, but the rate at which time itself progresses.

Matter as Trapped Light

If space is light moving and time is light progressing, what is matter? The answer follows naturally: matter is light that has become trapped in self-sustaining loops.

Under conditions of extreme energy density, the curvature of the electromagnetic field becomes so great that light paths bend back on themselves. When a path closes into a loop, it becomes stable—a standing wave pattern that persists without external energy input. These closed loops are what we call particles.

This explains mass. Mass is not an independent property but a measure of how much light is bound in these circular configurations. The more trapped light, the greater the mass. Einstein's equation $E = mc^2$ describes the conversion between free light (energy) and trapped light (mass), with c^2 as the proportionality constant between linear and circular motion.

It also explains why matter cannot travel at the speed of light. Trapped light already has an internal motion—the circulation of the loop. Adding external velocity is constrained by the total energy available. Free light, having no internal circulation, moves at maximum speed. Trapped light cannot.

Gravity as Field Strength

If matter is concentrated trapped light, and space is the light field itself, then gravity follows naturally. Gravity is the strength of the light field in a given region, determined by the sum of trapped light (mass) present.

This explains the inverse square law. Both light intensity from a source and gravitational force from a mass diminish as $1/r^2$. In standard physics, this is treated as a coincidence—two different phenomena that happen to follow the same geometric spreading. But if light and gravity are the same field, the identical falloff is not coincidental. It is inevitable.

Objects that do not emit visible light still have gravity because gravity depends on trapped light, not emitted light. A planet, a black hole, or a cloud of dark matter all contain mass—trapped light in various forms. That trapped light generates a field, and that field is what we measure as gravitational force.

This unification also explains why gravity is so weak compared to electromagnetism. Gravity is not a separate force transmitted by hypothetical gravitons. It is the large-scale structure of the light field itself, determined by the cumulative effect of all trapped light. Electromagnetic

interactions, by contrast, involve the direct exchange of free photons between charged particles, which is far more efficient at small scales.

The Acceleration of Cosmic Expansion

The most significant implication of this framework concerns the expansion of the universe. Observations show that expansion is accelerating—galaxies are receding from each other at an increasing rate. Standard cosmology attributes this to “dark energy,” a mysterious substance or field that comprises roughly 68% of the universe’s energy budget. Yet no one knows what dark energy is, where it comes from, or why it has the properties it does.

In the light-based framework, no dark energy is needed. The acceleration is a natural consequence of the changing ratio between trapped and free light over cosmic time.
Stars convert trapped light (mass) into free light (photons) through fusion and radiation. Over billions of years, the total mass in the universe decreases while the total amount of free light increases. This shifts the balance between gravitational attraction (which depends on trapped light) and spatial expansion (which depends on free light propagation).

In the early universe, trapped light dominated. Gravity was strong relative to the amount of space being generated. Expansion occurred but was slowed by gravitational attraction.
As stars burned and emitted radiation, the proportion of free light increased. Gravity weakened in relative terms—not because gravitational strength changed, but because there was less mass per unit volume to exert gravitational influence.

The result is accelerating expansion. It is not a push from mysterious dark energy but a release—a gradual reduction in the gravitational resistance to expansion as mass converts to radiation.

The relationship can be expressed as:
Expansion rate $\propto$ Free light / Trapped light

As the numerator increases and the denominator decreases, the expansion rate must increase. This is what we observe.

Black Holes and Singularities

Black holes represent the opposite extreme—maximum compression of trapped light. So much mass is concentrated in such a small region that even free light cannot escape. The gravitational field becomes so intense that it dominates all other effects.

At the center of a black hole, the mathematics predicts a singularity—a point of infinite density where general relativity breaks down. In the light-based framework, this makes sense. If space is constituted by light’s movement, and if light at the singularity cannot move, then space itself ceases to exist there. The singularity is not a point in space but a place where space ends.

Black holes do not persist forever. Hawking radiation predicts that they slowly evaporate, leaking trapped light back into free form over immense timescales. This is consistent with the principle that all traps are imperfect. No matter how compressed, trapped light eventually returns to a free state.

Dark Matter

Dark matter is detected only through its gravitational effects. It does not emit, absorb, or scatter light in any measurable way, yet it outweighs visible matter by roughly five to one. In the light-based framework, dark matter is simply trapped light in a configuration that does not interact electromagnetically.

Recent observations support this. NASA's discovery of Cloud-9—a massive cloud composed almost entirely of dark matter with minimal ordinary matter—shows that dark matter can exist in concentrated, stable structures. It has gravity (because it contains trapped light/mass) but no luminosity (because it does not emit photons). This is entirely consistent with the model.

We do not yet know what form of trapped light dark matter represents. It may be particles we have not yet detected or configurations of the field we do not yet understand. But its gravitational effects are real and arise from the same source as ordinary matter: the presence of mass as trapped light.

Cosmological Implications

If light is fundamental and space/time are emergent, the Big Bang takes on a different character. It was not the beginning of time or the creation of space from nothing. It was a phase transition—a moment when diffuse energy reached critical density and underwent rapid compression, trapping enormous amounts of light into matter.

There is no reason to assume this was the first such event. The observable universe extends back 13.8 billion years, but that is simply the limit of our information horizon. Earlier compression events may have occurred. The universe may be far older—perhaps eternal—with Big Bangs as recurring phenomena rather than singular creation events.

The ultimate fate of the universe depends on whether this process is cyclic. If trapped light continues leaking back to free form, and if expansion continues accelerating, the universe may end in a cold, diffuse state with almost no matter remaining—only radiation spreading through ever-expanding space.

Alternatively, dark matter may play a role in reversing expansion. If dark matter can concentrate sufficiently, it might condense space and trigger a new compression event. We do not yet know whether this occurs. The mechanism by which dark matter might accomplish this remains speculative.

Conclusion

The spacetime graph is a useful tool. It allows us to calculate trajectories, predict interactions, and solve problems. But it is not a description of reality. It is a human interface—a way of organizing information for ease of use.

When we set aside the graph and ask what space, time, matter, and gravity actually are, a simpler picture emerges. Space is light moving. Time is light progressing. Matter is light trapped in loops. Gravity is the field strength determined by trapped light. Cosmic expansion accelerates because the proportion of trapped to free light changes over time.

This framework does not require dark energy, does not require space and time to be fundamental, and does not require matter and light to be separate substances. It is a unified model where one phenomenon—light—accounts for the structure and behavior of the observable universe.

Whether this model is correct remains to be determined. It makes testable predictions, particularly about the relationship between stellar luminosity and expansion rates over cosmic time. But regardless of its ultimate validity, it demonstrates that the standard spacetime framework is not the only way to think about the universe. Alternative ontologies are possible, and some may be simpler than the conventional view.